

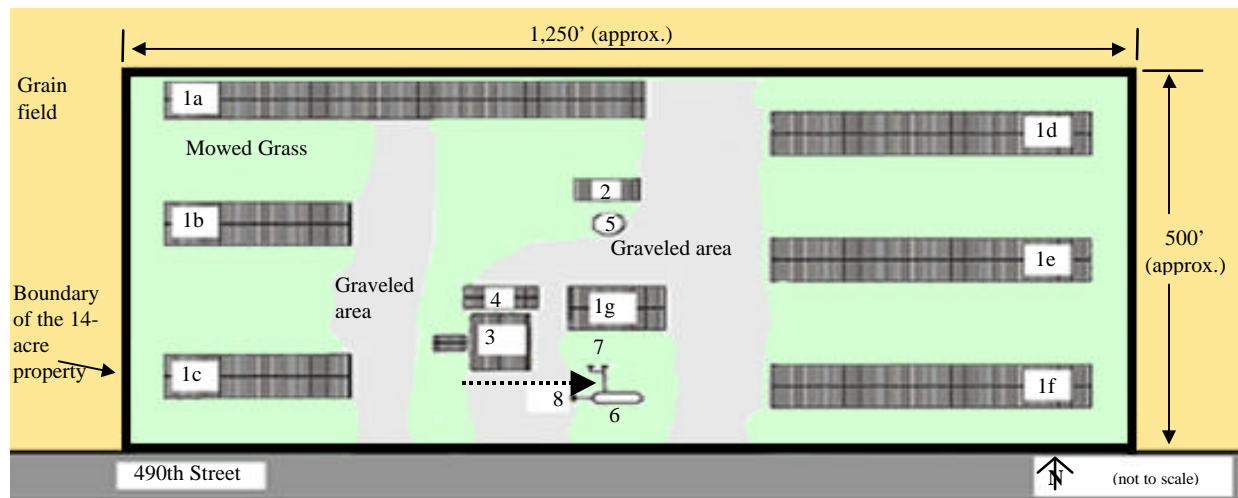
2.0 FARM OPERATION AND PROPANE SYSTEM

The farm, located on 14 acres in rural Iowa, housed approximately 50,000 turkeys in seven barns. In addition to its two co-owners, one full-time employee and two part-time employees were involved in operating the farm. The ATV was used solely for business purposes prior to the incident -- primarily the daily pickup of dead turkeys from the various building on the farm. The ATV towed a trailer, which was filled with turkey carcasses that were then deposited at a central collection point for pickup and disposal by a rendering company.

The Albert City area where the farm is located can be extremely cold during the winter months. For example, the mean daily temperature in January is 13.9°F. Even in April, the daily mean is approximately 46.7°F. Space heaters and furnaces provided heat for the farm's turkey barns. Fuel for these space heaters and furnaces was supplied by a propane storage and handling system that included a non-fireproofed⁵, 18,000-gallon propane tank located on the south side of the farm. (Propane is widely used on farms for heating and as a fuel for trucks, generators, and other farm equipment. According to the Iowa State Fire Marshal, the number of aboveground propane tanks in Iowa has increased significantly in recent years.)

This tank, which was originally fabricated in 1964, was installed on the farm in 1988. When the tank system was installed, Iowa law provided that the 1979 edition of the National Fire Protection Association's *NFPA 58 Standard for the Storage and Handling of Liquefied Petroleum Gases* governed the installation. At the time of the incident, the tank contained approximately 10,000 gallons of propane. The plot plan in Figure 2 on the following page shows the major buildings and structures on the farm. The dotted line represents the approximate path of the ATV that struck the propane piping near the tank.

⁵ Some propane storage tanks have an insulation-type fireproof coating applied to the outside of the tank to provide protection in a fire.



Major Buildings and Structures

1. Turkey barns (1a - 1g)
2. Machine shed
3. Office
4. Workshop
5. Feed storage bin
6. 18,000-gallon propane tank
7. Direct-fired vaporizers
8. Fueling truck point-of-transfer

Note:

1. Direct-fired vaporizers (Item 7) are located approximately 37 ft north of the 18,000-gallon propane tank (Item 6).
2. Fueling truck point-of-transfer (Item 8) is located approximately 40 ft west of the 18,000-gallon propane tank (Item 6).
3. South side of turkey barn 1g is approximately 87 ft north of the 18,000-gallon propane tank (Item 6).
4. Centerline of 490th Street is approximately 78 ft south of the 18,000-gallon propane tank (Item 6).

Figure 2. Plot Plan of Farm, 2243 490th Street, Albert City, Iowa

2.1 SYSTEM LAYOUT AND COMPONENTS

The propane tank, which was made of carbon steel, was approximately 42 feet long and 9 feet in diameter. It was located approximately 78 feet north of the 490th Street centerline (see Figure 2, item 6). The tank rested on two concrete saddles with the bottom of the tank located approximately 4 feet above ground level. Figure 3 is a view of the tank looking north from 490th Street.



Figure 3. The 18,000-gallon Propane Tank That Exploded

Aboveground piping from the tank ran in two directions:

- 1) Parallel liquid and vapor lines used for propane supply ran to the west for approximately 40 feet. These lines terminated at the fueling truck point-of-transfer located at the edge of a gravel parking area (see Figure 2, item 8 and Figure 7). These lines were not involved in this incident.
- 2) Parallel liquid and vapor lines also ran north from the tank for approximately 37 feet to two direct-fired vaporizers⁶ (vaporizers) (see Figure 2, item 7 and Figure 7). The liquid line was located to the east of the vapor line. The ATV struck these two lines.

Neither the tank nor the aboveground piping was protected by a fence or any other barrier designed to prevent damage from vehicles. According to one of the co-owners of the farm, the closest that vehicles came to the tank was when propane supply trucks parked at the fueling truck point-of-transfer to the west of the tank. There were no posted warnings for vehicles to stay out of the area immediately adjacent to the tank.

⁶ The direct-fired vaporizers were components of the system that used heat to transform liquid propane from the tank into a gas that was piped to space heaters and furnaces on the farm.

The first component in the liquid line leading to the vaporizer was a 3-inch excess flow valve. This metal valve was threaded into a 3-inch pipe coupling that was welded to the bottom shell of the tank. This excess flow valve was connected to a manual shut-off valve by a 2-inch diameter pipe (nipple) that was 2 inches in length. This metal 90°-angle valve changed the orientation of the liquid line from a downward direction to a horizontal and eastward direction. Two bushings (adapters designed to permit the joining of pipes with different diameters) connected the shut-off valve to a ¾-inch schedule 80 carbon steel pipe (outlet pipe). This outlet pipe ran to the east for approximately 30 inches toward the concrete saddle supporting the tank, and then turned downward for approximately 7 inches. This segment of pipe was subsequently labeled “A1” for evidentiary purposes (See Figure 4 below and Figure 29 in Appendix B). The outlet pipe then turned again to the north and ran to the vaporizers on a series of steel supports spaced at regular intervals. These supports placed the outlet pipe approximately 3 feet above the ground for its entire 37-foot course from the tank to the vaporizers. The arrows in Figure 4 point to liquid line components and to the approximate location of the break that occurred under the tank.

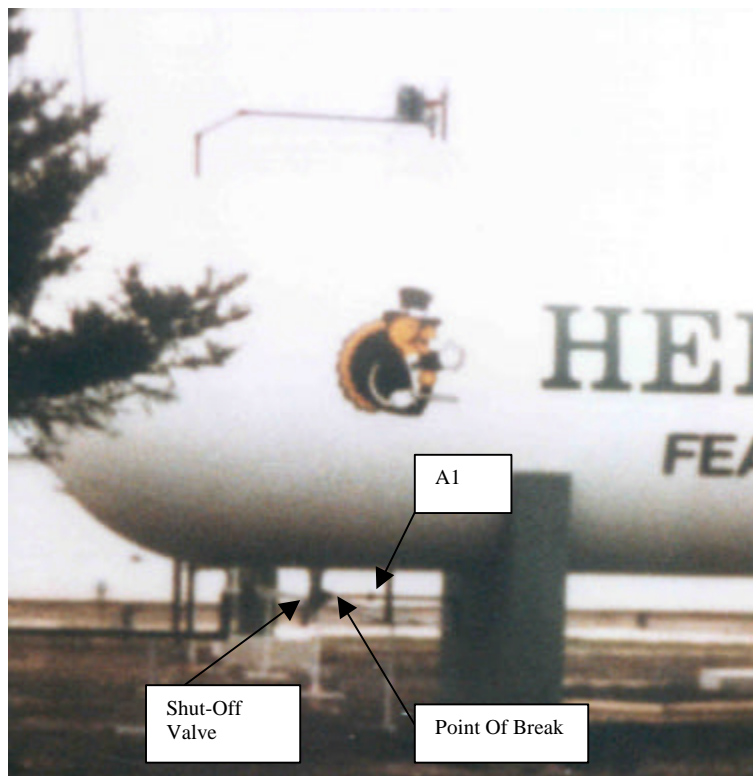


Figure 4. Liquid Line Shut-Off Valve and Point of Break

The vapor line involved in this incident exited the tank vertically from a 2-inch excess flow valve screwed into the manway⁷ on top of the tank. A small segment of pipe connected this excess flow valve to a shut-off valve. This 90°-angle valve changed the course of the vapor line to a horizontal direction. The vapor line then ran northward until it extended beyond the side of the tank and then ran downward to the same elevation as the liquid line. From this point, the vapor line ran parallel to the liquid line on the same series of steel supports until both lines reached the vaporizers. Figures 5a and 5b are photographs of the west end of the tank that illustrate the vapor lines exiting the manway. The arrows point to the vapor line that ran to the vaporizers.



Figure 5a. Southern Exposure



Figure 5b. Northern Exposure

Piping from the vaporizers to the various buildings was buried underground. Figure 6 on the following page is a piping diagram for the propane storage and handling system.

⁷ The manway was a lid on the top of the tank that housed the following components: two vapor excess flow valves and three pressure relief valves. See Appendix B, Figure 6.

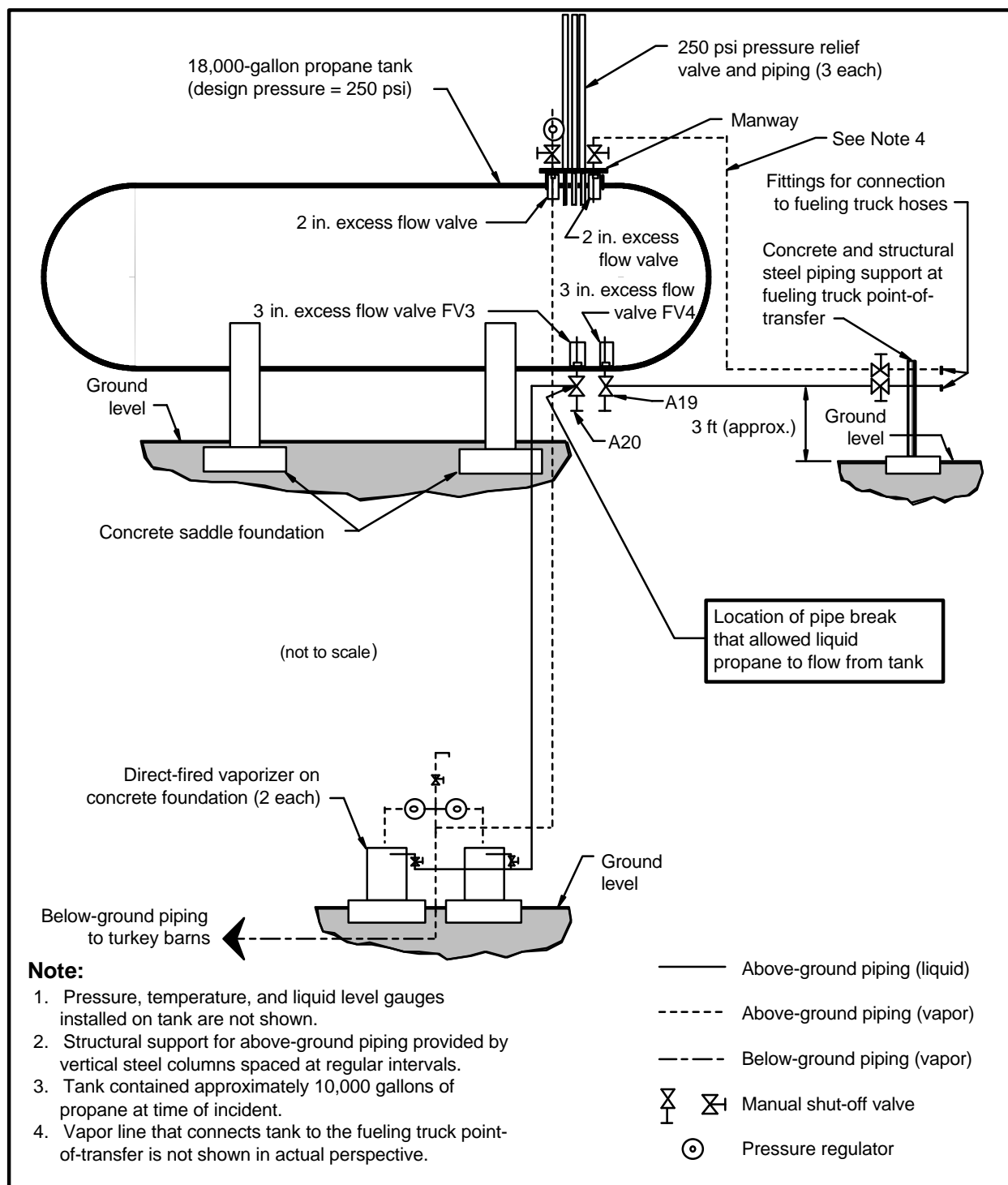


Figure 6. Piping Diagram for the Propane Storage and Handling System

2.2 SYSTEM OPERATION

During normal operations, liquid propane was withdrawn from the tank through the 3-inch excess flow valve (FV3 in Figure 6), past the open shut-off valve (A20 in Figure 6), and then into the ¾-inch outlet pipe to the vaporizers shown in Figure 7. These vaporizers used heat to convert the liquid propane into a gas. After passing through a pressure regulator, the propane gas was piped underground to the various space heaters and furnaces located in the buildings on the farm.

On cold winter days, as much as 1,000 gallons of propane were required to heat the buildings and structures on the farm. Based on this usage, fueling truck deliveries occurred as often as every week during severe winter months. When a fueling truck arrived at the farm, it parked in the gravel area located west of the propane tank (see Figure 2, item 8). The dotted arrow in Figure 7 below represents the approximate course of the ATV prior to striking the propane lines.

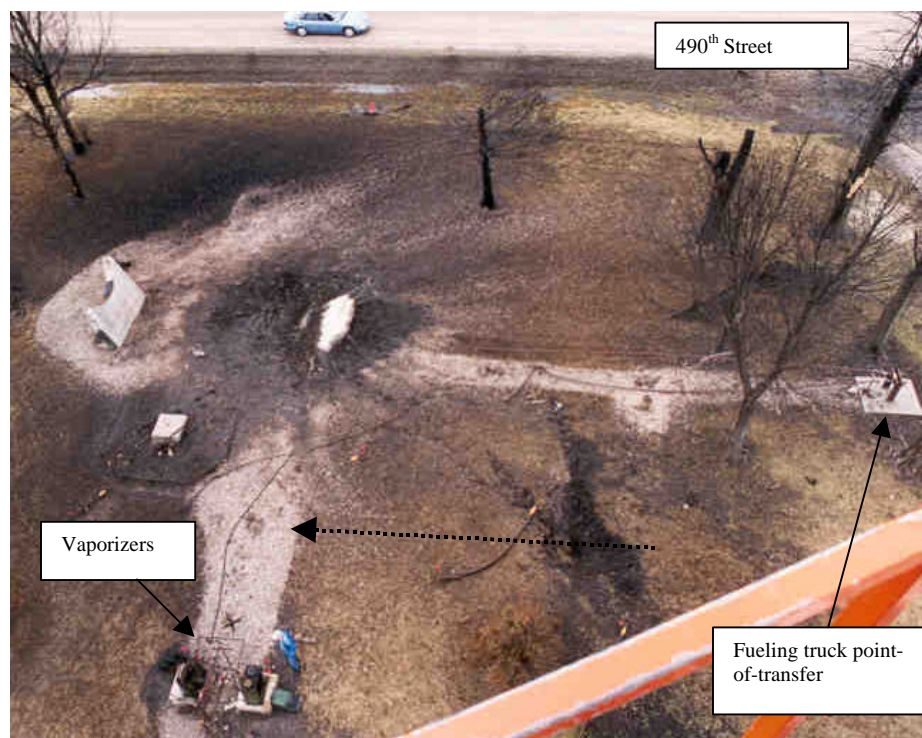


Figure 7. Aerial View of Tank Area